

Access and Connection



transport choice

Overview



Indicator name	Bus and strategic freight reliability		
Indicator number	6	Indicator type	Supplementary
Objective	To measure the level of consistency of transport services for bus and strategic freight related trips		
Application guidance	<p>Places do not exist in isolation from each other, and people within them form part of a wider community across the town, city or region. Public transport provides equitable and efficient access to and from more distant places, and deliveries and servicing are essential to create vibrant places. Both modes should be provided at the appropriate priority to their frequency and service type to enable connected and reliable journeys.</p> <p>This indicator will support practitioners to understand the consistency of travel times across different days and/or times of day. Based on the outcome of the assessment, practitioners can determine whether improvements could be made to address poor performance.</p> <p>Practitioners can use the <i>planning time per kilometre</i> metric to measure the total travel time that a traveller needs to allow to ensure that they arrive on time most of the time.</p> <p>Practitioners can use the <i>buffer time per kilometre</i> metric to measure the additional time that a traveller needs to allow for unexpected delays to ensure that they arrive at their destination on time and is a measure of variability.</p> <p>Practitioners can use the <i>typical delay time per kilometre</i> metric to measure the average variation in travel time from the free flow travel time and reflects traffic efficiency, such as the level of traffic congestion.</p>		

Metric



- Planning time per kilometre
- Buffer time per kilometre
- Typical delay time per kilometre

Recommendation



N/A

Related indicators



Access and Connection

- 4 Public transport accessibility
- 5 Freight network accessibility



Metric – Planning time per kilometre

Metric unit	Seconds per kilometre (s/km)
Description	To measure the planning time, which represents the total time that a traveller needs to plan for a trip to allow them to arrive at their destination on time 95% of the time
Spatial coverage	NSW Urban areas (buses only) and all NSW for freight
Spatial application	This metric is most suitable for link-based analysis based on the road network
Calculation methodology	<ol style="list-style-type: none">1. Obtain road segment length2. Calculate the 95th percentile travel time from all observations across the relevant peak period and date range of interest

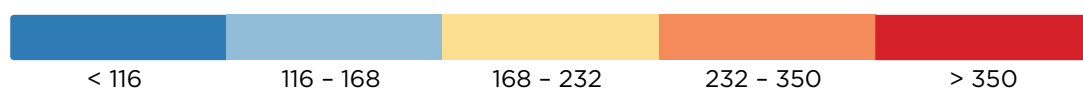
$$\text{Planning Time per kilometre} = \frac{95^{\text{th}} \text{ percentile of travel time}}{\text{Length of section (km)}}$$

Note: 95th percentile represents the near-worst case scenario and can be interpreted as travellers' chance of being late to reach their final destination one weekday per month

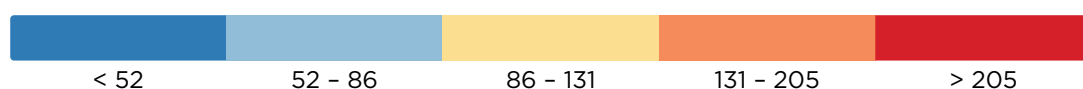
3. Assign colour based on the classification below

Unit: Seconds per kilometre (s/km)

Bus planning time per kilometre



Freight planning time per kilometre



Assumption	<ul style="list-style-type: none">• Travel time and travel speed data is continuously available in all roads (ie. arterial and local roads)• Planned and unplanned incident data should be reviewed to identify when prolonged incidents such as roadworks or other incidents impact on a significant proportion of a link for an extended period• January performance is impacted by public and school holidays and does not reflect what may be considered 'normal' operations. Traffic volumes change in school holiday periods and this should be considered when reviewing quarterly and annual reports.• Verification and cleansing of data should be undertaken before applying it for calculating the performance measures• All travel time reliability data is provided in five peak hour periods:<ul style="list-style-type: none">– Typical weekday AM Peak between 6am and 10am– Typical weekday Inter Peak between 10am and 3pm– Typical weekday PM Peak between 3pm and 7pm– Typical weekday evening between 7pm and 10pm– Weekend Peak between 10am and 3pm• Typical weekdays include Tuesday, Wednesday and Thursday and excludes both school and public holidays• Travel time reliability is calculated for individual hours and the slowest hour within each peak period is provided. The use of the slowest hour will ensure that all poor performance sections are taken into consideration.
-------------------	--



Metric – Planning time per kilometre (Cont.)

Assumption

- Length of road sections should be considered in the calculation of travel time reliability, as poor performing short sections may have less impact on a journey than a poor performing long section
- Presenting and reporting the duration of poor performance is also important for planning purposes because poor performance over multiple hours has more detrimental impacts on traffic performance than in a single hour. Accordingly, for individual project locations individual hourly metrics should be considered.

Limitation

- Travel time and travel speed data in local roads or remote rural areas may be unavailable or have only small sample size
- Peak spreading will not be identified by looking only at the worst performing hour in a peak period. For site specific projects, calculation and review of metrics for each hour between 6am and 10pm is recommended.

Data source

Freight

- HERE Travel Time Data
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc).

Buses

- TfNSW, Bus Opal Assignment Model (BOAM): available on request by Advance Analytics and Insight (AAI)
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc).



Metric – Buffer time per kilometre

Metric unit	Seconds per kilometre (s/km)
Description	To measure the buffer time (the difference between the 95th percentile travel time and the average travel time)
Spatial coverage	NSW Urban areas (buses only) and all NSW for freight
Spatial application	This metric is most suitable for link-based analysis based on the road network
Calculation methodology	<ol style="list-style-type: none">1. Obtain road segment length2. Calculate the 95th percentile and average travel time from all observations across the relevant peak period and date range of interest

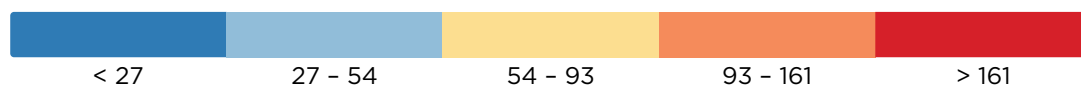
$$\text{Buffer Time per kilometre} = \frac{95^{\text{th}} \text{ percentile of travel time} - \text{average travel time}}{\text{Length of section (km)}}$$

Note: 95th percentile represents the near-worst case scenario and can be interpreted as travellers' chance of being late to reach their final destination one weekday per month

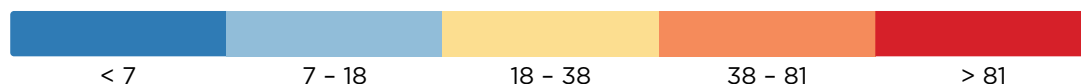
3. Assign colour based on the classification below

Unit: Seconds per kilometre (s/km)

Bus buffer time per kilometre



Freight buffer time per kilometre



Assumption

- Buffer time represents “the extra time (buffer) most travellers add to their average travel time when planning trips” (TTI, 2005, pp. 8-33)
- Buffer time is the primary metric to use when assessing travel time variability as it indicates the spread or dispersion of travel times away from the average travel time. A large buffer time means the 95th percentile travel time is much higher than the average travel time, and customers can expect more variability in their travel time along the route or segment. The smaller the buffer time, the less variability the customer will experience as the 95th percentile travel time moves closer to the average travel time.
- Not all travellers suffer buffer time costs, only those that need to arrive at their destination by a specific time. If the traveller has flexibility around their arrival time, then they will only suffer from typical delay time.
- Travel time and travel speed data is continuously available in all roads (ie. arterial and local roads)
- Planned and unplanned incident data should be reviewed to identify when prolonged incidents such as roadworks or other incidents impact on a significant proportion of a link for an extended period
- January performance is impacted by public and school holidays and does not reflect what may be considered ‘normal’ operations. Traffic volumes change in school holiday periods and this should be considered when reviewing quarterly and annual reports.
- Verification and cleansing of data should be undertaken before applying it for calculating the performance measures



Metric – Buffer time per kilometre (Cont.)

Assumption

- All travel time reliability data is provided in five peak hour periods:
 - Typical weekday AM Peak between 6am and 10am
 - Typical weekday Inter Peak between 10am and 3pm
 - Typical weekday PM Peak between 3pm and 7pm
 - Typical weekday evening between 7pm and 10pm
 - Weekend Peak between 10am and 3pm
- Typical weekdays include Tuesday, Wednesday and Thursday and excludes both school and public holidays
- Travel time reliability is calculated for individual hours and the slowest hour within each peak period is provided. The use of the slowest hour will ensure that all poor performance sections are taken into consideration.

Limitation

- Travel time and travel speed data in local roads or remote rural areas may be unavailable or have only small sample size
- Peak spreading will not be identified by looking only at the worst performing hour in a peak period. For site specific projects, calculation and review of metrics for each hour between 6am and 10pm is recommended.
- Length of road sections should be considered in the calculation of travel time reliability, as poor performing short sections may have less impact on a journey than a poor performing long section
- Presenting and reporting the duration of poor performance is also important for planning purposes because poor performance over multiple hours has more detrimental impacts on traffic performance than in a single hour. Accordingly, for individual project locations individual hourly metrics should be considered.

Data source

Freight

- HERE Travel Time Data
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc)

Buses

- TfNSW, Bus Opal Assignment Model (BOAM): available on request by Advance Analytics and Insight (AAI)
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc)



Metric – Typical delay time per kilometre

Metric unit	Seconds per kilometre (s/km)
Description	To measure the difference between the average travel time and the free flow travel time, which reflects the extra time a journey takes due to the time of day at which the journey is made
Spatial coverage	NSW Urban areas (buses only) and all NSW for freight
Spatial application	This metric is most suitable for link-based analysis based on the road network
Calculation methodology	<div><div><div>1. Obtain road segment length</div><div>2. Calculate average travel time from all observations in the relevant peak period and date range. Calculate the free flow travel time</div></div><div>$\text{Typical delay time per kilometre} = \frac{\text{Average travel time} - \text{free flow travel time}}{\text{Length of section (km)}}$</div><div><div>3. Assign colour based on the classification below</div><div>Unit: Seconds per kilometre (s/km)</div><div>Bus delay time per kilometre<div><div>< 19</div><div>19 – 34</div><div>34 – 55</div><div>55 – 98</div><div>> 98</div></div><div>Freight delay time per kilometre<div><div>< 4</div><div>4 – 11</div><div>11 – 24</div><div>24 – 49</div><div>> 49</div></div></div></div></div></div>
Assumption	<ul style="list-style-type: none">• Free flow speed “is the average speed that can be accommodated under relatively low traffic volumes (no vehicle interactions) on a uniform roadway segment under prevailing roadway and traffic conditions” (TTI, 2005, pp. 5-7)• Free flow travel time is defined as the 15th percentile of the off-peak travel time (Racca and Brown, 2012, pp.46)• Where free flow speed exceeds posted speed limit (PSL), the free flow travel time should use the travel time at the PSL level. This is to avoid any “illegal impression” issue of using free flow speed which is greater than the PSL.• The off-peak period and hence free flow period is more difficult to define for buses as not all bus services are available at night and additional bus services run during AM and/or PM peak hours (daytime). For these metrics the 15th percentile travel time will be calculated for each individual hour between 6am and 10pm, and the minimum of the hourly values used as the free flow travel time.• Freight off-peak period is defined as overnight from 10pm to 6am• Travel time and travel speed data is continuously available in all roads (ie. arterial and local roads)• Planned and unplanned incident data should be reviewed to identify when prolonged incidents such as roadworks or other incidents impact on a significant proportion of a link for an extended period• January performance is impacted by public and school holidays and does not reflect what may be considered ‘normal’ operations. Traffic volumes change in school holiday periods and this should be considered when reviewing quarterly and annual reports.• Verification and cleansing of data should be undertaken before applying it for calculating the performance measures



Metric – Typical delay time per kilometre (Cont.)

Assumption

- All travel time reliability data is provided in five peak hour periods:
 - Typical weekday AM Peak between 6am and 10am
 - Typical weekday Inter Peak between 10am and 3pm
 - Typical weekday PM Peak between 3pm and 7pm
 - Typical weekday evening between 7pm and 10pm
 - Weekend Peak between 10am and 3pm
- Typical weekdays include Tuesday, Wednesday and Thursday and excludes both school and public holidays
- Travel time reliability is calculated for individual hours and the slowest hour within each peak period is provided. The use of the slowest hour will ensure that all poor performance sections are taken into consideration.
- Length of road sections should be considered in the calculation of travel time reliability, as poor performing short sections may have less impact on a journey than a poor performing long section
- Presenting and reporting the duration of poor performance is also important for planning purposes because poor performance over multiple hours has more detrimental impacts on traffic performance than in a single hour. Accordingly, for individual project locations individual hourly metrics should be considered.

Limitation

- Travel time and travel speed data in local roads or remote rural areas may be unavailable or have only small sample size
- Peak spreading will not be identified by looking only at the worst performing hour in a peak period. For site specific projects, calculation and review of metrics for each hour between 6am and 10pm is recommended.

Data source

Freight

- HERE Travel Time Data
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc)

Buses

- TfNSW, Bus Opal Assignment Model (BOAM): available on request by Advance Analytics and Insight (AAI)
- Manual collection of data from field surveys (ie. field observation, questionnaires or interviews, vehicle classification surveys, etc)

Reference



- Federal Highway Administration, United States Department of Transportation, Travel Time Reliability: Making It There On Time, All The Time (2017): ops.fhwa.dot.gov/publications/tt_reliability/ttr_report.htm
- Texas Transportation Institute (TTI), The Keys to Estimating Mobility in Urban Areas: Applying Definitions and Measures that Everyone Understands, A White Paper Prepared for the Urban Transportation Performance Measure Study, Second Edition (2005): citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.177.9361&rep=rep1&type=pdf
- Racca, P.D. and Brown, D.T., Study and Calculation of Travel Time Reliability Measures, Prepared for the Delaware Department of Transportation, Centre for Applied Demography and Survey Research, University of Delaware (2012): udspace.udel.edu/bitstream/handle/19716/13239/GPStraveltimereliabilityfinalreport.pdf?sequence=1&isAllowed=y